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Linear stability analysis of axisymmetric flow over a sudden expansion in an annular pipe BEHNAZ BELADI, HENDRIK CHRISTOPH KUHLMANN, TU Wien — A global temporal linear stability analysis is performed of the fully-developed axisymmetric incompressible Newtonian flow in an annular pipe with a sudden radially-inward expansion. The geometry is characterized by the radial expansion ratio (radial step height to the outlet gap width) and the outlet radius ratio (inner-to-outer radius). Stability boundaries have been calculated with finite volumes for an outlet radius ratio of 0.1 and expansion ratios from 0.25 to 0.75. For expansion ratios less than 0.55 the most dangerous mode has an azimuthal wave number $m = 3$, whereas $m = 2$ for larger expansion ratios. An a posteriori analysis of the kinetic energy transferred between the basic state and the critical mode allows to check the energy conservation and to identify the physical instability mechanism. For all expansion ratios considered the basic flow arises as an annular jet between two separation zones which are located immediately after the step. The jet gradually widens downstream before reattaching to the cylinders. The deceleration of the flow associated with the widening of the jet is found to be the primary source of energy for the critical modes.

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